

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 54

April, 1952

No. 640

THE NORTH AMERICAN REPRESENTATIVES OF SMELOWSKIA (CRUCIFERAE)

W. H. DRURY, JR.¹ AND REED C. ROLLINS

IN a revision of the genus *Smelowskia* for North America by one of us (Rollins, 1938), typical *S. calycina* was considered to be present in both Asia and North America. Though originally described from the Altai Mountains of Siberia, this species was shown to be widely distributed in the Rocky Mountain and Cascade Ranges of western North America. In that paper, the suggestion was made that the Siberian and North American populations are the remains of a once continuous distribution and that var. *integrifolia*, occupying certain Bering Sea coastal sites in Alaska and Siberia, is a trace population situated along or near the migration route from one continent to the other. Thus *S. calycina* was thought to be the key species tying together the Asiatic and American elements of the genus. Assuming an Asiatic origin, the existence of *S. ovalis* in Washington, Oregon, and northern California seemed to point to a relatively minor differentiation of the genus once it was established on the American continent. That this is an oversimplified statement of the situation has become increasingly clear as new materials have accumulated.

A year ago (Rollins, 1950) *Smelowskia Holmgrenii*, an apparently restricted species in Nevada, was added to the genus. But of even greater significance, contributing toward a more thorough understanding of *Smelowskia*, has been the rapid assembly of new collections from Alaska and western Yukon Territory. Perhaps of greatest importance, from our particular

¹ The Society of Fellows of Harvard University.

point of view, was the discovery of a new species, *S. pyriformis*, found in limestone slide-rock on Farewell Mountain on the northwest edge of the Alaskan Range. Some features of this species immediately raised the question as to the relationships of *Smelowskia* and a group of plants variously placed in the genera *Melanidion*, *Acroschizocarpus* and *Ermania*.

THE PROBLEM OF GENERA

In a recent treatment of the Alaska and Yukon representatives of this alliance, Hultén (1945) recognized *Smelowskia calycina* subsp. *integrifolia* and *Ermania borealis*. In the latter species, he placed plants described originally by Greene (1912) as *Melanidion boreale* and by Gombocz (1940) as *Acroschizocarpus Kolianus*. As a result of our studies, we agree that these two, *Melanidion* and *Acroschizocarpus* are congeneric and conspecific, but we believe that there are four varieties represented in the material available to us. Furthermore, we find that the natural relationships of these plants are found in *Smelowskia* rather than in the genus *Ermania* as Hultén concluded.

In setting up the genus *Melanidion*, Greene pointed to such characteristics as (1) the greatly elongated inflorescence, (2) the whitened villous pubescence, (3) the persistent purplish calyx, (4) the obsolete septum, and (5) the formation of a thick narrow wing-like projection around the replum formed by turned valve margins, as being distinctive. Comparing these points in turn with *Smelowskia*, we find the following: (1) The exaggerated length of the inflorescence is not significant because the racemose inflorescence tends to vary greatly in length, this variability being well shown in *Smelowskia calycina*. The subsecund position of the pedicels results from the stems lying on the ground. The pedicels on the lower side of the axis naturally turn toward the upper side, thus producing a feature noted as distinctive by Greene, but one that is not found on stems growing upright. Subsecund inflorescences are also found in prostrate plants of *S. calycina*. (2) *Smelowskia* characteristically has a whitened villous pubescence. (3) A persistent calyx is present in typical *S. calycina* and this is a characteristic feature of *S. ovalis*. Therefore, it could scarcely be made the basis of a new genus. As to the purple color, this is commonly found in both the sepals and

petals of many populations of *S. calycina*. (4) The septum is very thin in *Smelowskia* and is commonly perforate in *S. ovalis*. Siliques with a perforate septum can be found in *S. calycina* though it is an uncommon feature of that species. Actually, with more material for study than was available to Greene, it is clear that the septum is not consistently obsolete in the species he called *Melanidion boreale*, as pointed out by Porsild (1945). In young siliques, the septum is complete, but as maturation of the silique proceeds it may be sufficiently stretched to produce a perforation, or at maturity the septum may be almost completely torn apart. However, siliques can be found on the same plant with an entire septum, a perforate septum, or one that is torn and nearly obsolete. (5) An interesting feature of the siliques of *Melanidion boreale* is the thick wing-like ridge formed by the compressed edges of the valves where they come together over the replum. The valves actually extend beyond the replum margin in a perpendicular fashion. But this is not a unique characteristic of *M. boreale*. A less-developed ridge is present in *Smelowskia ovalis* and *S. calycina*. In *S. pyriformis* there is a very marked ridge present, being even more prominent than in *M. boreale*. Finally, there is considerable variation within the species *M. boreale* (*Smelowskia borealis*) on this character. In var. *villosa*, the ridge is no better developed than in *S. calycina* and in var. *Koliana*, the development is like that in *S. ovalis*.

In connection with an evaluation of *Acroschizocarpus*, Hultén (1945) has provided an excellent analysis. He points out the regular agreement in major characteristics of the genus of Gombocz (1940) and *Melanidion*. Furthermore, his suggestion that the supposedly distinctive dehiscence of the siliques, i. e. from the top of the valve downward, is at least partly the result of pressure being placed upon the specimens while they were being dried, seems valid. In a relatively short unflattened fruit of the type present on these plants, any pressure is more direct on the shortest axes, which in this case is toward the sides and apex. However, even if pressure is not the major factor in bringing about an opening of the silique at the apex first, this feature is not sufficiently marked to be significant. In most *Cruciferae* with short siliques, there is but little if any difference in timing of valve abscission between the lower and upper portions of the

silique. We note a tendency for the valves to open toward the top first in *Smelowskia pyriformis* as well as the material formerly placed in *Melanidion* and *Acroschizocarpus*, but this does not appear to be a significant departure from the usual situation in other short-fruited *Cruciferae*.

The type species of *Ermania*, *E. Parryoides*, might with some propriety also be included in *Smelowskia*. However, that species has siliques definitely flattened parallel to the septum and the fruit is of an elongated type not unlike that of *Parrya* or *Arabis* where it has been placed at one time or another. If one follows the interpretation of Schulz (1936), *Ermania* consists of a group of species of central and southern Asia with affinities in a direction away from *E. Parryoides* and quite unlike any species of *Smelowskia*. Hultén's action in placing *Melanidion boreale* in *Ermania* was not completely unjustified if *Smelowskia* and particularly the new *S. pyriformis* which he has not had the opportunity to study, were not taken into account. From *S. calycina*, which we might think of as a central point of reference in *Smelowskia*, there is a stepwise progression of relationship to *S. ovalis*, *S. pyriformis*, and *S. (Melanidion) borealis*. Basically, all of these species have the same type of growth-form, leaves, pubescence, inflorescence, flowers, fruits, and seeds. There is not a single characteristic so far discovered that would justify separating any one of them into a genus different from the rest.

THE CYTOLOGICAL EVIDENCE²

Viable seeds of the Alaskan *Smelowskia borealis*, var. *villosa* (Olaus Murie, Aug. 16, 1950) were received through the kindness of Mr. A. E. Porsild of the National Museum of Canada. Successful cytological preparations were made from this Alaskan plant and four collections of *S. calycina*, var. *americana* from Wyoming, Colorado, and Utah (*Rollins & Porter 51274*; *Rollins & Weber 5161* and *5162*; *Rollins 51219*). The chromosome number was the same in all five collections ($2n = 12$, Fig. 1). Observations were made on root-tip preparations from germinated seeds, except in nos. 5161 and 5162, where suitable figures were found in cells of ovary tissue.

² We are very much indebted to Dr. L. O. Gaiser for the information upon which these cytological notes are based and for the drawings of Figure 1.

The karyotypes of *S. borealis*, var. *villosa* and *S. calycina*, var. *americana* were similar in many ways, the individual chromosomes being of the same general size and shape and showing the

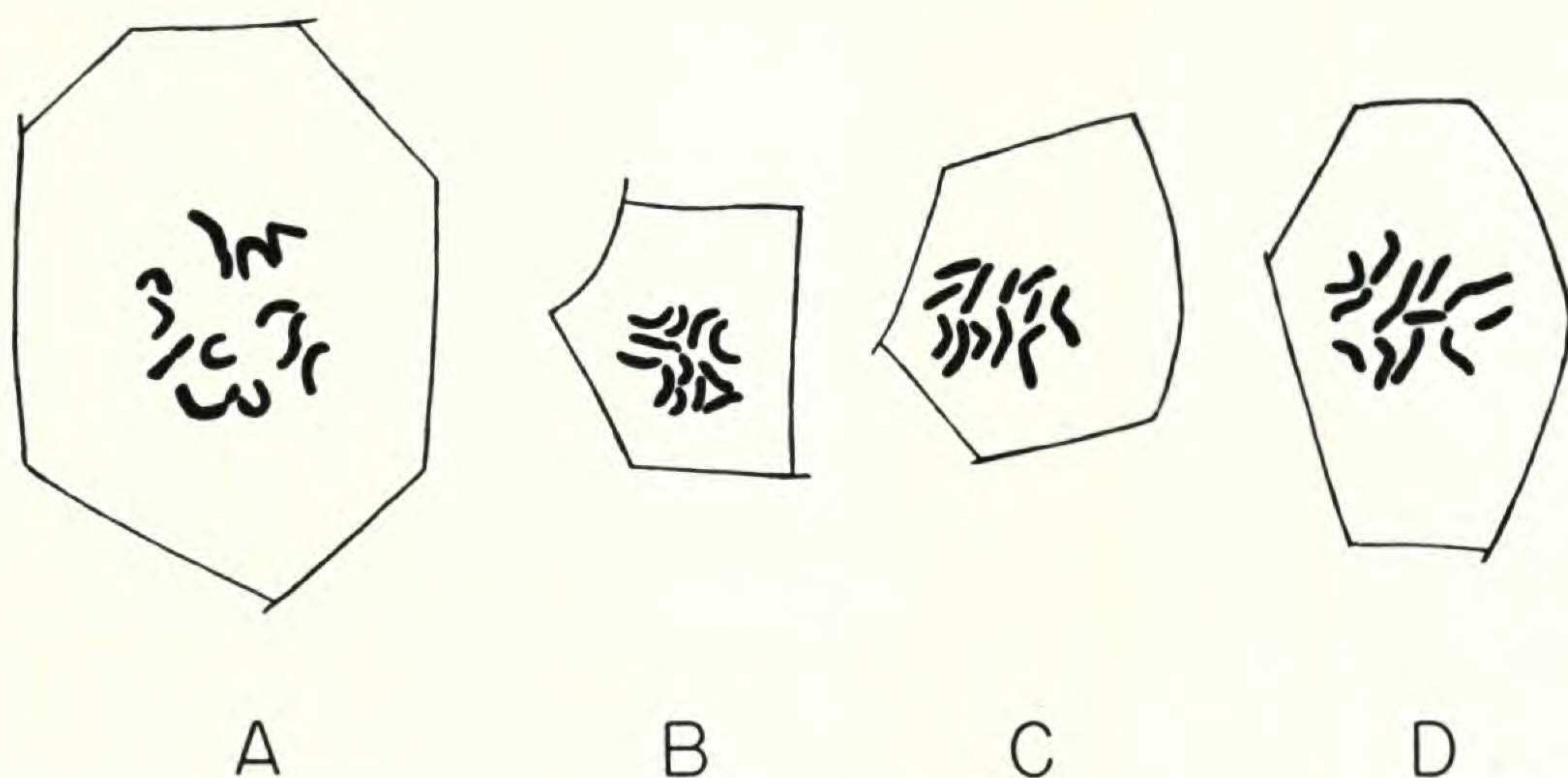


FIG. 1. CHROMOSOMES OF SMELOWSKIA. $\times 2000$

A. *S. borealis*, var. *villosa*. Large periblem cell from root-tip. Seeds from top of Sable Mountain, Mt. McKinley National Park, Alaska, collected by Olaus Murie s. n., Aug. 16, 1950. (Specimen in the Herbarium of the National Museum of Canada.)

B., C., and D. *S. calycina*, var. *americana*. B. Cell of ovary tissue. Material collected at 12,500 ft. on Hoosier Ridge, Summit Co., Colorado, Reed C. Rollins and William A. Weber 5161 (Spec. in Herb. Gray and Univ. of Colorado). C. Periblem cell of root-tip. Seeds collected at 10,000 ft. on Clay Butte, Northwestern Park Co., Wyoming, Reed C. Rollins and C. L. Porter 51274 (Spec. in Herb. Gray and Univ. of Wyoming). D. Periblem cell of root-tip. Seeds collected at 11,000 ft. in the Tushar Mts., 12 miles west of Marysvale, Piute Co., Utah, Reed C. Rollins 51219 (Specimen in Herb. Gray).

same general range of types. Among the chromosomes of *S. borealis*, there were two pairs of distinctly greater length than the rest. The chromosomes of one of these pairs were subterminally constricted, those of the other pair showing median constrictions. A medium pair was also subterminally constricted. The well-spread karyotype figured consisted of an additional rod-shaped pair and two successively shorter V-shaped pairs which were medium to somewhat shorter. All showed median constrictions.

In the karyotypes of *S. calycina*, var. *americana* there were two longer pairs. One pair showed submedian constriction, the other median constriction. A pair of medium length had sub-

terminal constriction and three medium to shorter pairs of chromosomes were constricted at or near the median point. The karyotypes of the four different collections of this variety were uniform.

It is evident from a critical comparison of the karyotypes of the two species that they are basically similar. The differences found are of the sort that might more reasonably be expected in two species of the same genus rather than two distinct genera. Thus the cytological evidence so far obtained supports our conclusions that "*borealis*" is congeneric with *Smelowskia calycina* and is therefore properly placed in the genus *Smelowskia*.

While observing *Smelowskia calycina*, var. *americana* on Hoosier Ridge, Summit County, Colorado, it was noted that some clumps of this plant possessed relatively much larger flowers than others of the same colony. The possibility of polyploidy being present to account for the larger flower-size was immediately recognized and fixations and specimens of the large- and small-flowered forms were made. Number 5161 represents the large-flowered form, no. 5162 the small-flowered form. However, polyploidy was not found, the chromosome number in both collections being $2n = 12$ as indicated above. That there is actually a rather marked difference in the size of the flowers of the two is borne out by measurements of the specimens collected. An explanation of these easily observed differences obviously does not lie in a simple diploid-polyploid relationship of the two forms and must be sought elsewhere.

THE *S. CALYCINA* COMPLEX

Smelowskia calycina is at once the most variable and widely distributed species of the genus. Recent treatments of Asiatic material referable to this species (Busch, 1939; Schulz, 1924) show variants thought worthy of nomenclatural designation, such as vars. *glabrata* and *pectinata*, in addition to var. *calycina* with which the type is associated. The American populations of this species deviate in certain respects from the Altai plants and are set apart as four varieties. The most widespread of these is var. *americana*, occurring from Colorado and Utah to southern Alberta and British Columbia and in the Cascade Mountains of western Washington. Though formerly treated as typical *S. caly-*

cina (Rollins, 1938), this variety differs in having a more slender and longer silique which tapers in a balanced way from the middle in both directions. The American plants consistently shed the calyx while it is persistent in Siberian material. Variety *americana* is closest to var. *media*, a somewhat variable population of northern Yukon and northeastern Alaska.

On the barren hilltops of northwestern Alaska, var. *integrifolia* survives as a clearly marked taxon with entire or shallowly few-toothed cauline leaves and short-petioled oval to ovate basal leaves that are entire or shallowly lobed at their apices. The siliques are borne on widely divergent pedicels and are considerably shorter and more asymmetrical than those of var. *americana*. In the mountain areas of the interior of Alaska, there appears another variety with usually entire cauline leaves, long-petioled (as long or longer than the blades), and narrowly oblanceolate entire to very rarely shallowly lobed basal leaves. The latter we have named var. *Porsildii*. In a key position phylogenetically is var. *media* which connects the American varieties with those of Asia. This population appears to be variable both as to the extent and nature of lobing of its basal and cauline leaves and as to the shape of its siliques. From the limited specimens we possess, the total range of variation cannot be satisfactorily determined, but it seems clear that an accentuation of various trends could have produced the other taxa of the *calycina* complex in North America. *S. calycina* on the North American continent, then, is composed of four infraspecific taxa that are geographically separated but intergrade in certain morphological characters.

THE *S. BOREALIS* COMPLEX

The *Smelowski borealis* group is remarkable for the extremes of variation found in the siliques. Members of the population in the east, var. *borealis*, in the Mackenzie Mountains, have firm, ovate, short pods with conspicuous secondary nerves. Plants from the Brooks Range and the western Richardson Mountains, var. *Jordalii*, have spatulate, membranaceous pods. The populations of the Alaska Range are of two types: the siliques are elongate-oblong and firm in var. *villosa*, and elongate-oval and membranaceous-inflated in var. *Koliana*. However, the flowers and vegetative parts of these plants are remarkably uniform and

largely form the basis for including them within a single species. If only the extremes of variation are considered, it would be very hard indeed to admit that the latter two populations belong to the same species. It is almost as if in this plastic extreme of a plastic group, the *Cruciferae*, we are able to see a group of new species in the process of formation. Such extremes of variation are not unexpected in a plant series in which populations have become isolated under conditions where intense selection-pressure is operative. We do not agree with Gombocz who created a new genus to accommodate the plants here called var. *Koliana*. Hultén (1940 and 1945) convincingly showed the unity of *Melanidion* and *Acroschizocarpus*, and that intermediates between the taxa separately described under these two genera occur. But our greater material indicates that there is a taxon present in the population of the Alaska Range, originally described as *A. Kolianus*, which we are maintaining as a variety.

THE GEOGRAPHICAL DISTRIBUTION

The geographical distribution of the known species of *Smelowskia* strongly supports the suggestion made of a formerly continuous population from Siberia across Alaska, down the mountain chain into the United States. Fragments of this once continuous population are what concerns us in this paper (Fig. 2).

Smelowskia calycina, var. *americana* is the most widespread, and the commonest in herbaria. It centers along the Rocky Mountain continental divide from Banff National Park in southern Alberta and British Columbia south to the San Juan Mountains of southern Colorado, but apparently not into New Mexico. The range extends in the south from the Front Range in Colorado to the Wasatch Mountains in Utah, with but a few scattered populations on the isolated mountain ranges in the Great Basin of Utah and Nevada. From Colorado, the main population follows the sinuous course of the Rocky Mountains west through the Uinta Mountains and north to Yellowstone Park. There the population extends from the Lewis and Absaroka Ranges in Montana and Wyoming west to the Salmon River and Wallowa Mountains of Idaho and Oregon. The variety is again found in the Cascade and Olympic Mountains of Washington.

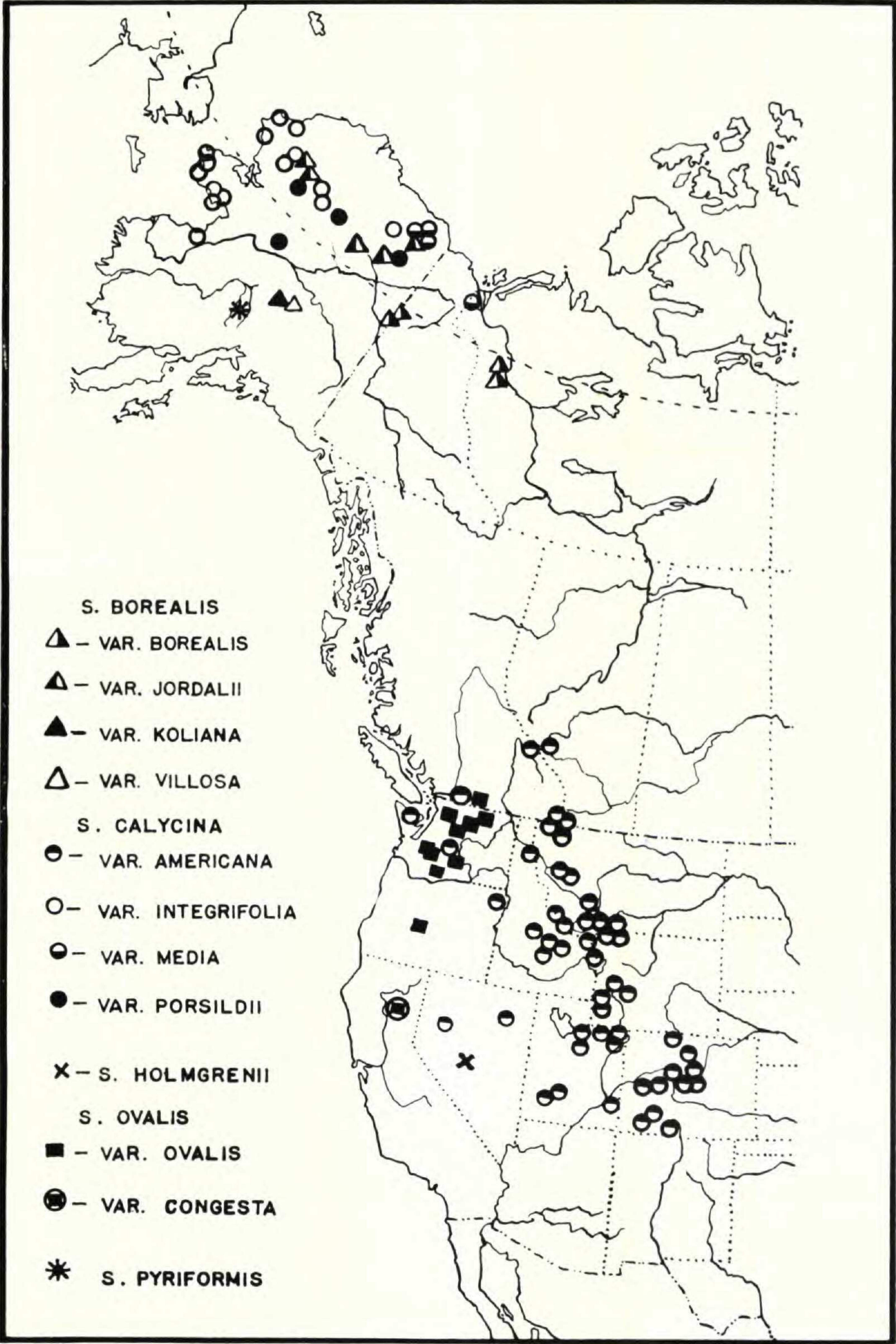


FIG. 2. THE GEOGRAPHIC RANGES OF SMELOWSKIA IN NORTH AMERICA.

As Rollins (1938) pointed out, there are variations on the margins of this range. Plants of the Olympic Mountains population differ in features of indument and length of inflorescence, while those in southern Utah have noticeably short and fat pods. In the northern extreme of the Rocky Mountain chain, *S. calycina*, var. *media* occupies the Richardson Mountains along the continental divide between the Brooks Range and the Mackenzie Mountains. *S. calycina*, var. *integrifolia* is found in a half-moon shaped area on the north slope of the Brooks Range, the northwest arctic coast, around to Seward Peninsula and the Norton Sound area. *S. calycina*, var. *Porsildii* occurs on the south slope of the Brooks Range and the western part of the Yukon Plateau in the drainage that runs into the Yukon from the north. These elements can be suggested to have survived pretty much *in situ* in the general region that Hultén (1937) has called the "North Beringian Refugium." The populations must have survived as isolated units in a general area of persistence of plant species. Furthermore, it may well be that the extensive variation within var. *integrifolia* in the Norton Sound area reflects the mingling of the northern population with a small one from a second general area of survival, "southern Beringia."

Smelowskia borealis in the collections available to us, shows four populations: (1) in the Brooks Range, (2) in the Ogilvie-Selwyn part of the Mackenzie Mountains, and (3) and (4) in the northwest part of the Alaska Range. *Smelowskia pyriformis*, also in the northwestern Alaska Range, is a member of this variable complex, but definitely of specific rank.

Smelowskia ovalis is distributed in the Cascade Mountains of Oregon and Washington, while *Smelowskia Holmgrenii* occurs very locally in southwestern Nevada.

The great majority of these plants grow at high altitudes, on gravel ridges, open slopes and slide-rock. The relative rarity of the genus in collections (except for *S. calycina*, var. *americana*) combined with the frequent comment on abundance where found, seems to indicate what Fernald (1925) has called "species senescence." There are a number of small, isolated populations occupying specialized environments. The populations seem not to have migrated far from their areas of survival.

The evident adaptation of the species is to the highest altitudes

and bleak, exposed summits: *S. ovalis* is reported at the highest levels at which vascular plants grow on Mount Rainier; *S. calycina*, var. *integrifolia* at the highest altitudes from the Brooks Range, and var. *americana* from the highest peaks of the Rocky Mountains; *S. borealis*, var. *villosa* from the top of Sable Mountain, Mount McKinley National Park. Thus it would appear that survival occurred in relatively small populations scattered over the mountainous regions of America where rocky remnants were not covered by Pleistocene ice. This type of population survival produces numerous, scattered, small, rather homogeneous groups. These would not lend themselves to organization into an historical geographical pattern, because they probably have not expanded from their areas of survival. It is possible that the mere existence of a population of the genus indicates an area of persistence. Such survival areas must have been especially common in the huge, partly glaciated areas of the mountains of interior Alaska. The specific and infra-specific segregations in the genus strongly support this conception of its historical and geographical development.

The present geographical distribution indicates that the genus formerly extended, probably without disruption, from the Altai to the cordillera of the United States. However, present knowledge of the species would indicate that it is probably not the case that the center of origin was in central Siberia where there are two species, but rather in the mountains of North America where there are five. If such an area is suggested, it is possible to visualize the spread of the genus in both directions, into Siberia to the west and along the Rocky Mountain chain to the south. It would seem dangerous to suggest Alaska as such a center, because the nature of survival of the genus in that area (in small isolated populations) would lead to exaggeration of any variations already in existence in the ancestral stock. Such a type of variation is an artifact of the history of the plant, not evidence of a center of dispersal.

If central Siberia be suggested as a center of dispersal, it would be necessary to explain why there was little spread to the west while the genus extended northeast to the American continent and down half its length.

The most reasonable center of dispersal would appear to be

somewhere in the northern cordillera region of North America, although the evidence is not conclusive for either an American or an Asiatic origin for the genus.

In the citation of specimens, the following abbreviations have been used for the herbaria from which material was obtained: Natural History Museum, Stockholm (S); Chicago Museum of Natural History (C); Gray Herbarium (G); National Museum of Canada (Can); R. S. Sigafos personal collection (specimens not yet distributed) (Sig); United States National Herbarium (US); University of Minnesota (M); University of Wyoming (W). We would like to express our appreciation to the curators of these herbaria who have kindly loaned us specimens for examination.

KEY TO THE SPECIES

- Leaves stiff, entire and glabrous except for small, marginal, tooth-like trichomes; stems greenish and glabrous. 1. *S. Holmgrenii*.
 Leaves soft and pliable, usually lobed, densely pubescent with matted trichomes; stems canescent.
 Caudex mostly branched, slender; stems usually simple, each arising from a separate caudex branch; pedicels divaricate to ascending.
 Mature siliques oblong, tapering at both ends; sepals caducous (in the American varieties); basal leaf-bases strongly ciliate with long acicular trichomes. . . . 2. *S. calycina*.
 Mature siliques ovate to slightly oblong; truncate at the base; sepals persistent; basal leaf-bases not ciliate. 3. *S. ovalis*.
 Caudex mostly simple, stout (more than 5 mm. in diameter); stems branched from near the base upwards, becoming decumbent in fruit; pedicels widely divergent to arcuate.
 Basal leaves pinnately cut to the midrib the full length of the blade, ca. 9-lobed; petals white or cream-colored; sepals tan, ca. 1 mm. long; siliques elongate pear-shaped, 5-6 mm. long, ca. 2 mm. wide, tan. . . 4. *S. pyriformis*.
 Basal leaves palmately 3-5-lobed, lobes short; petals purple; sepals purple, ca. 2.5 mm. long; siliques broadly ovate to oblong, or linear, 5-19 mm. long, 3-6 mm. wide. 5. *S. borealis*.

1. *Smelowskia Holmgrenii* Rollins

S. Holmgrenii Rollins, Contrib. Gray Herb. 171, p. 50 (1950).

Caespitose perennial of alpine rocky places, with a deep tap root branching at the crown; caudex thick, 5-10 mm. in diameter, 1-3 cm. long, branched, densely covered with old leaf-bases, each sobole terminating in a dense crown of leaves; stems several, slender, glabrous, terete, erect, somewhat gyrate, branched above, 1-2 dm. high; basal leaves

petiolate, stiff, erect, lanceolate to linear-oblong, acute, 2–5 cm. long, 3–5 mm. wide, blade tapering very gradually into the petiole, glabrous except the margins which are sparsely ciliolate; petioles 5–25 mm. long, ca. 1 mm. wide, glabrous except the margins which are sparsely ciliolate; leaf-bases glabrous, sparsely ciliolate on the margin; cauline leaves 3–5, linear, glabrous, 1–2 cm. long, 1.5–3 mm. wide. Inflorescence racemose, 5–15 cm. long in fruit; pedicels glabrous, straight, ascending, filiform, slightly expanded above, 3–8 mm. long; sepals caducous, linear-oblong, non-saccate, scarious-margined, purplish, glabrous, ca. 2 mm. long and 1 mm. wide; petals white, spatulate, 3.5–4.5 mm. long, ca. 1.5 mm. wide, claw about one-half the blade length; stamens nearly equal; filaments terete, ca. 2 mm. long; anthers oval, less than 0.5 mm. long; siliques erect linear-oblong, tapering at base and apex, slightly flattened parallel to septum, 5–12 mm. long, 1–1.5 mm. wide; firm, not inflated; valves nerveless or very slightly nerved at the base, purplish, depressed between the seeds; style less than 0.5 mm. long; stigma entire, unexpanded; seeds brown, wingless, not flattened, ca. 2 mm. long, ca. 1 mm. broad, slightly pointed at each end, in a single row in the siliques; radicle slightly exceeding the cotyledons at the funicular end; cotyledons incumbent. (Illustrated Plate 1185: C 1–4). UNITED STATES. **Nevada:** Locally frequent, crevices of rocks in rocky prominence above middle fork of Pine Creek, Toquima Range, 10,000 ft., Nye Co., August 4, 1947, *Arthur H. Holmgren* and *Cecil Ballenger 7076* (Type) (G); other specimens from the same general location: Summit above Pine Creek Basin, 11,300 ft., July 16, 1945, *Bassett Maguire* and *A. H. Holmgren 25814* (G); same location, 11,400 ft., July 17, 1945, *Maguire* and *Holmgren 25829* (G).

This species is fully discussed and illustrated (Fig. 1, p. 49) in Rollins, 1950 (Contrib. Gray Herb. 171, pps. 48–51, 1950).

2. *Smelowskia calycina* (Stephan) C. A. Meyer

Perennial plant of arctic-alpine gravels and slide-rock; caespitose, the caudex branched, up to 10 cm. long or longer, clothed with persistent leaf-bases; root stout and long with few coarse branches; stems few to numerous, simple, 1.5 to 20 cm. long, sparsely to densely pubescent with short branched and long simple or few-branched trichomes; basal leaves along 1–3 cm. of caudex, few to numerous, petiolate, blades shorter to longer than petioles, linear to obovate, entire to pinnately divided, 3–25 mm. long and 1–16 mm. wide, segments short and rounded to oblong or cuneate 1–9 mm. long, sparsely to densely whitish puberulent with short chiefly branched trichomes and sparsely hirsute with simple trichomes; petioles 1–70 mm. long, usually puberulent and hirsute with short branched, and long simple trichomes; leaf-bases straw-colored, glabrous on the back, strongly ciliate on the margin with long white acicular trichomes; cauline leaves 1–9, linear and simple to ovate and deeply pinnately divided, 3–30 mm. long, similar to the basal but with shorter petioles, lobes if present more linear, tending to be reduced upward on the stem. Inflorescence single, in fruit 1.5–10 cm. long; pedicels ascending to

widely divaricate, in fruit 3–10 mm. long, pubescent with long usually simple trichomes; sepals oval or oblong, 2–3.5 mm. long, 1–1.5 mm. wide, pubescent on the back with long simple trichomes, tan or pink with a colorless or pink hyaline margin, persistent or caducous; petals white or cream to lavender, rounded at the apex, differentiated into claw and blade, 3–8 mm. long (blade 2.5–4 mm. long), 2–4 mm. wide; filaments flattened, 1.5–3 mm. long; anthers cordate-ovate, 0.5–0.8 mm. long; siliques linear to narrowly oblong, broadest at or above the middle, tapering at both ends, 4–13 mm. long, 1–2.5 mm. wide, glabrous or rarely pubescent with simple hairs, slightly flattened parallel to the septum or terete, sometimes slightly curved in the same plane as the replum when young; tip of the replum acute beneath the style; valves nerved from base to apex by a strong single nerve half way between the valve margins, smooth or with inconspicuous, anastomosing, impressed secondary nerves; style 0.5 or less to 1.5 mm. long, stigma usually expanded in fruit; seeds few (1–10), 2–2.5 mm. long, wingless; cotyledons incumbent.

KEY TO THE AMERICAN VARIETIES OF *S. CALYCINA* AND VARIETY *CALYCINA*

Sepals persistent; plants of central Siberia 2a. var. *calycina*.

Sepals caducous; plants of North America.

Basal leaves entire or shallowly lobed at the tips; cauline leaves entire or shallowly 3-lobed.

Basal leaf-blades obovate to oval; petioles shorter than the leaf-blades; pedicels widely divaricate, angle of divergence between 60° and 90° 2b. var. *integrifolia*.

Basal leaf-blades linear to narrowly spatulate; petioles longer than the leaf-blades; pedicels divaricately ascending, angle of divergence less than 60° 2c. var. *Porsildii*.

Basal leaves pinnately lobed or with some leaves nearly entire in var. *media*; cauline leaves pinnately lobed.

Pedicels widely divaricate, angle of divergence 50° to 80°; siliques broadest above the middle; cauline leaves few-lobed, 2–3 per stem 2d. var. *media*.

Pedicels ascending, angle of divergence less than 50°; siliques broadest at the middle, tapering equally above and below; cauline leaves many-lobed, 3–7 per stem 2e. var. *americana*.

2a. ***Smelowskia calycina*, var. *calycina***

S. calycina C. A. Meyer in Ledeb. Fl. Alt. III: 170 (1831).

Lepidium calycinum Stephan in Willd. Spec. Pl. III¹: 433 (1801).

Hutchinsia calycina Desv. Journ. Bot. III. 4: 168 (1814); DC. Syst II: 388 (1821) & Prodr. I. 178 (1824); Ledeb. Fl. Ross. I: 200 (1842).

Stem ca. 8–11 cm. long, sparsely pubescent with short branched and long simple or few-branched trichomes; basal leaves oblong to oval, ca. 5–12 mm. long, ca. 2–5 mm. wide, pinnately 7–9 divided, segments oblong to cuneate, ca. 1–3 mm. long, pubescent with chiefly short branched trichomes; petioles ca. 1–2.5 cm. long, pubescent; cauline leaves ca. 5, deeply pinnately divided, the lobes fewer and shorter upward on the stem,

ca. 7 on the lower, nearly sessile upward, petioles ca. 9 mm. at the base. Inflorescence in fruit ca. 1.5–3 cm. long; pedicels in fruit divaricately ascending, angle of divergence 45° to 65° ; sepals persistent, oblong, 2–3 mm. long; petals white to cream-colored, ca. 4–5 mm. long; siliques broadly oblong, ca. 6–9 mm. long, 2 mm. wide, slightly flattened parallel to the septum; style 0.5–1.2 mm. long; stigma expanded in fruit; seeds few (ca. 6). (Illustrated Plate 1185: F 1–4.)

The species is distributed in central Siberia from Taschkent, eastern Turkestan to the Altai Mountains. SIBERIA: Locality uncertain: Herbar. Bung. Flor. orient. altaica. 1839 (G); nov. sp. e Siberia (probably isotype) (S).

This variety is characterized by widely divaricate pedicels, persistent calyx, and rather fat and flattened siliques. The cauline leaves are 5–7-lobed and the basal leaves 7–9-lobed.

2b. **Smelowskia calycina**, var. **americana** (Regel & Herder.) comb. nov.

Hutchinsia calycina β *americana* Regel & Herder, Bull. Soc. Nat. Mosc. XXXIX²: 101 (1866).

S. calycina, prol. *americana* O. E. Schulz in Engler, Pflanzenr. IV¹⁰⁵: 356 (1924).

S. americana Rydb. Bull. Torr. Bot. Club XXIX: 239 (1902). Not based on var. *americana* of Regel and Herder.

S. lineariloba Rydb. Bull. Torr. Bot. Club XXXI: 555 (1904).

S. lineariloba, f. *virescens* O. E. Schulz in Engler, Pflanzenr. IV¹⁰⁵: 357 (1924).

S. lobata Rydb. Bull. Torr. Bot. Club XXXIX: 327 (1912).

Stem 4–20 cm. long, pubescent with short branched, and long simple or few-branched trichomes; basal leaf-blades oblong to oval 0.5–(1–2)–5 cm. long, 4–(6)–16 mm. wide, pinnately divided, segments oblong to cuneate, 2–(4)–12 mm. long, sparsely to densely pubescent to canescent with chiefly short branched trichomes; petioles 3–(15)–70 mm. long, pubescent; cauline leaves 3–9, grade into the basal, deeply pinnately divided (–13 lobes) near the base of the stem, sessile to 17 mm. petiolate, 5–29 mm. long, with fewer lobes upward on the stem. Inflorescence in fruit 2–(3–6)–10 cm. long; pedicels in fruit ascending or divaricately ascending, angle of divergence less than 50° ; sepals caducous, oblong, 2–3.2 mm. long; petals white to cream-colored or rarely pink to lavender, 3–(5–6)–8 mm. long; siliques narrowly oblong to linear, 5–9 mm. long, slightly flattened parallel to the septum or terete; style 0.2–1 mm. long; stigma expanded in fruit; seeds few (6–10). (Illustrated Plate 1185: A 1–4.)

Southern Colorado, Utah, and Nevada north in the Rocky Mountains to Alberta and British Columbia and in the Cascades and the Olympic Mountains of Washington. For citation of specimens, see RHODORA Vol. 40, pp. 297–299, August 1938.

This taxon is characterized by its ascending pedicels, caducous calyx, and relatively slender, terete to somewhat flattened siliques. The cauline leaves are 5–13-lobed and the basal leaves usually 7–11-lobed although they vary from 5–13 lobes. These plants are characteristically rather densely caespitose. The variation in the population has been discussed by Rollins (1938). It suffices to repeat that plants from the Olympic Peninsula of Washington tend to have a longer inflorescence, more cauline leaves (6–10 rather than 3–6) with broad, blunt segments arranged sub-palmately, and basal and cauline leaves conspicuously canescent. Scattered colonies from as far north as Waterton Lakes in Canada, in Washington and in Wyoming, but especially in southern Utah closely approximate the typical variety in their short and fat siliques.

Flower size and color have been shown to vary over broad limits within one population. On Hoosier Ridge, Colorado, there is a population the flowers of which may be white, cream, or lavender. Petal length in this population varies from 4 mm. to 8 mm. and width from 2 mm. to 5.5 mm. On Uncompahgre Peak, Colorado, a population has been seen with deep lavender or purple flowers.

2c. **Smelowskia calycina**, var. **media** var. nov.

Stems up to 13 cm. long, sparsely pubescent with short branched, and long simple or few-branched trichomes; basal leaf-blades broadly oblong to ovate, 0.8–1.5 cm. long, subentire with 1–3 short teeth to deeply pinnately divided, the segments 2–4 mm. long and oblong to elongate oval, densely whitish puberulent with short branched and sparsely hirsute with simple trichomes; petioles 5–12 mm. long, pubescent and hirsute; cauline leaves 2–5, grade into the basal, may be simple at the base of the inflorescence and deeply pinnately divided (7-lobed) near the base, short petioled, ovate-spatulate to linear, 3–9 mm. long. Inflorescence single, in fruit 2–5.5 cm. long, pedicels in fruit widely divaricate, their angle of divergence 50° to 80°; sepals caducous, ca. 2 mm. long; petals ca. 5 mm. long; siliques narrowly oblong, 5–8 mm. long, not flattened; style 0.5 mm. long or less; stigma expanded in fruit; seeds few (1–5). (Illustrated Plate 1185: E 1–3.)

Herba perennis, foliis basalibus oblongis vel ovatis, subintegris vel alte pinnate 7-lobatis; foliis caulinis alte pinnate 7-lobatis vel sursum integris; sepalis caducis; pedicellis late divaricatis, angulo 50°–80°.

The Richardson Mountains of northeastern Alaska and northern Yukon Territory. **Alaska:** Shaviovik River, E. Fork, alone in crevices, 3500 ft. ridge top, common, lat. 69° 21' N., long. 146° 43' W., May 30, 1947, L. A.

Spetzman 208 (M); Shavirovik River, E. Fork, on outcrops and rocky talus, common, lat. $69^{\circ} 28' N.$, long. $146^{\circ} 35' W.$, June 13, 1947, *L. A. Spetzman 266* (M); Arctic north slope, Ignek Valley, sandstone slope, common, lat. $69^{\circ} 35' N.$, long. $145^{\circ} 10' W.$, elev. 3000 ft., Aug. 3, 1948, *L. A. Spetzman 1318* (S, M); Arctic north slope, Lake Schrader, sunny sandstone mountain slope, common, lat. $69^{\circ} 25' N.$, long. $145^{\circ} 00' W.$, elev. 4000 ft., July 10, 1948, *L. A. Spetzman 653* (Type at Minnesota) (S, M). CANADA: **Northwest Territories**: Eastern slope of Richardson Mts., west of Mackenzie River delta, from 1,000 to 4,000 feet above sea level, approx. lat. $68^{\circ} N.$, and long. $136^{\circ} W.$, barren alpine ridges, June 16, 1931, *O. Bryant 6596* (Can); Eastern slope of Richardson Mts., west of Mackenzie River delta, from 1,000 to 4,000 feet above sea level, approx. lat. $68^{\circ} N.$, and long. $136^{\circ} W.$, barren gravel ridges, 3000', July 7–10, 1933, *A. E. Porsild 6680* (Can); Eastern slope of Richardson Mts., west of Mackenzie River delta, from 1,000 to 4,000 feet above sea level, approx. lat. $68^{\circ} N.$ and long. $136^{\circ} W.$, barren alpine ridges, August 15–17, 1933, *A. E. Porsild 6821* (Can).

This variety is characterized by divergent pedicels, caducous calyx, rather short and fat siliques, and but few, few-lobed stem leaves. The cauline leaves are 3–7-lobed and the basal are entire or 3–7-lobed. The plant is usually rather densely caespitose. The population is closely related to the plants of the central and southern Rocky Mountains from which it differs in its divergent pedicels and fewer stem leaves. Variety *media* is also related to the plants from the Altai area of Siberia from which it is most conveniently distinguished by its caducous calyx. Specimens that are intermediate between var. *media* and var. *integrifolia* are found on the western edge of the Richardson Mountains.

The characteristics of its variation and the resemblance of this population both to var. *calycina* of the Altai area and var. *americana* of the Rocky Mountains seem to indicate that it is close to the ancestral type of *S. calycina* in Alaska before differentiation into local populations took place. The limited number of collections, however, prevent us from establishing the real limits of variation.

Porsild (1943 and 1951) refers this population to *Smelowskia calycina* (var. *americana* of the present treatment) rather than its var. *integrifolia*, which were the two taxa he dealt with. He is certainly right in his decision of relationships. He comments (1943), "Although the plants flower profusely, the fruiting is very poor, and but a single silique, containing one good seed,

could be found." However, we were able to get good fruiting material from L. A. Spetzman's collections from northeast Alaska.

2d. **Smelowskia calycina**, var. **integrifolia** (Seeman) Rollins

Hutchinsia calycina, var. *integrifolia* Seeman, Bot. Voy. Herald: 25 (1852).

H. calycina, var. β Hook. Fl. Bor.-Am. I: 59 (1830).

H. calycina, var. γ Ledeb. Fl. Ross. I: 201 (1842).

S. calycina, prol. *americana* f. *integrifolia* O. E. Schulz in Engler, Pflanzenr. IV¹⁰⁵: 356 (1924).

S. calycina, subsp. *integrifolia* Hultén, Lunds Univ. Årssk. **41**: 869 (1945).

Stem 2.5–15 cm. long, pubescent with short branched and long simple or few-branched trichomes; basal leaf-blades narrowly to broadly oblong, cuneate at the base and entire or less often broadly oblong to spatulate, rounded to cuneate at the base with 1–5 blunt, shallow teeth toward the apex, densely whitish puberulent with short branched trichomes, and sparsely hirsute (more so in exposed locations) with long simple or few-branched trichomes, 3–(5–8)–12 mm. long and 1–(3–5)–8 mm. wide; petioles 1–(5)–9 mm. long, pubescent and hirsute; cauline leaves 1–(3)–7, 4–6 mm. long, on petioles 0.5–7 mm. long, entire or usually 1–(3)–5-toothed toward the base of the stem. Inflorescence single, in fruit 2–8 cm. long; pedicels in fruit widely divaricate, the angle of divergence 60° to 90°; sepals caducous, oval or oblong, 2–3.5 mm. long; petals 3.5–(4)–6 mm. long; siliques narrowly oblong, 4–(6)–13 mm. long, not flattened; style 0.5 mm. long or less; stigma usually expanded in fruit; seeds few (1–5). (Illustrated Plate 1185: 1–4.)

Northwestern Alaska; the north and west slopes of the Brooks Range, the northwest Arctic coast, and south across Seward Peninsula to the east shore of Norton Sound. **Alaska:** Norton Sound: low volcanic hills at Qiqertariaq, 63° 35' N., 161° W., elevation about 1,000 feet, barren gravelly ridges, July 27, 1926, A. E. and R. T. Porsild 1056 (S, G, Can, US); Seward Peninsula: south coast near Bluff, 64° 33' N., 163° 45' W., elevation sea-level to 1,500 feet, dry gravelly slope, August 5–6, 1926, A. E. and R. T. Porsild 1240 (S, G, Can, US); same locality, collectors and date, 1240 A (Can, G); dry slopes, Anvil Mt., 5 miles north of Nome City, August 16, fr., July 8, fl., 1900, J. B. Flett 1631 (US); vicinity of Nome, Anvil Mt., June 29, 1918, C. W. Thornton 307 (US); Nome, Anvil Hill, and Dexter Creek, about 64° 30' N., 165° 20' W., elevation sea-level to 1,500 feet, barren gravel ridges, August 6–10, 1926, A. E. and R. T. Porsild 1358 (G, Can); Nome, Alaska, on Anvil Ridge, alt. 500 feet, slope 20%, moisture fair, soil rocky loam, associated plants: *Salix reticulata*, *Rhododendron* —, *Anemone multiceps*, *Myosotis alpestris*, distribution wide, abundance scattered, June 23, 1929, W. B. Miller 128-c (US); Nome, July 1936, G. N. Jones 9094 (S); Nome, on Seward Peninsula, Aug. 3–4, 1949, E. Scamman 5373 (G); Nome, Anvil Hill, loose rocky slopes, Cooper Gulch, NE facing, July 19, 1949, M. D. and R. S. Sigafos 1696 (Sig); Nome,

Anvil Hill, steep, calcareous, south-facing rocky slope, July 20, 1949, *M. D. and R. S. Sigafos 1858* (Sig); Nome, Anvil Hill, thin soil, marble cliff, July 31, 1949, *M. D. and R. S. Sigafos 2259* (Sig); Nome, Anvil Hill, calcareous rocky slope, Aug. 6, 1949, *M. D. and R. S. Sigafos 2545* (Sig); Kigluaik Mts., Mt. Distin, steep creek, east-facing talus slope, Aug. 29, 1949, *M. D. and R. S. Sigafos 3131* (Sig); Port Clarence, July 12, 1899, *F. V. Coville and T. H. Kearney, Jr., 1898a* (US); vicinity of Port Clarence, Teller Reindeer Station, on gravelly flats near beach, July 14, 1901, *F. A. Walpole 1444* (US); Teller, Aug. 1901, *E. O. Campbell* (US); Teller Reindeer Station, vicinity of Port Clarence, on gravelly flats, Sept. 9, 1901, *F. A. Walpole 2041* (US); Teller, on Port Clarence, Bering Strait, Teller Mission, Aug. 6–20, 1949, *E. Scamman 5524* (G); York Mts., Lost River, 100 ft. terrace 2 mi. west of river, June 16, 1950, *M. D. and R. S. Sigafos 3512* (Sig); York Mts., Lost River, 50 ft. terrace west of river, June 18, 1950, *M. D. and R. S. Sigafos 3397* (Sig); North-west Arctic coast: North shore Kotzebue Sound, at Kivalina or Kotzebue, 1930, *Mrs. D. A. Wagner 1* (US); Cape Lisburne, Aug. 7, 1938, *J. P. Anderson 4520* (S); along the Kukpowruk River, NW Alaska, between latitudes $68^{\circ} 30'$ and 60° (sic) $30'$ N., June–July 1949, *R. M. Chapman 155* (US); Brooks Range: Lake Noluk, dry conglomerate rubble mountain top, $\frac{1}{2}$ mi. S. of the lake, common, lat. $68^{\circ} 47'$ N., long. $160^{\circ} 00'$ W., elev. 2700 ft., June 9, 1950, *L. A. Spetzman 3513* (M); Nuka River, south facing slope, common, lat. $68^{\circ} 45'$ N., long. $159^{\circ} 45'$ W., elev. 2000 ft., June 13, 1950, *L. A. Spetzman 3622* (M); Lake Noluk, conglomerate ridge $\frac{1}{2}$ mi. S. of the Lake, abundant, lat. $68^{\circ} 47'$ N., long. $160^{\circ} 00'$ W., June 28, 1950, *L. A. Spetzman 3676* (M); dry rocky ridges, 1 mi. southwest of Lake Noluk, lat. $68^{\circ} 47'$ N., long. $160^{\circ} 00'$ W., north slope of the Brooks Range, Arctic Alaska, elev. 2300 ft., July 30, 1950, *H. J. Thompson 1312* (G); Sagavanirktok River, W. Fork, 130 mi. from Arctic Ocean, high sandstone hogback, scarce, lat. $68^{\circ} 45'$ N., long. $148^{\circ} 45'$ W., elev. 4000 ft., June 8, 1946, *L. A. Spetzman 32* (M); N. of Brooks Range, Oolamnavik River, west of Killik River, $68^{\circ} 35'$ – $154^{\circ} 30'$, June 18, 1946, *R. M. Chapman 64* (US). Doubtful specimens (incomplete): Nimiuktuk River, sandstone rubble slopes, abundant, lat. $68^{\circ} 20'$ N., long. $159^{\circ} 55'$ W., elev. 1500 ft., June 10, 1950, *L. A. Spetzman 3558* (M); Killik R., N. facing Mt. summit ridge, quartzite shale, s. s. (sandstone) rubble, sparse growth in crevices, lat. $68^{\circ} 15'$ N., long. $154^{\circ} 00'$ W., elev. 6100 ft., Aug. 15, 1949, *A. Lachenbruch 35* (M) (may be var. *Porsildii*).

This variety is characterized by widely divergent pedicels, caducous calyx, husky and often purple-tinted siliques and few, entire to 3-lobed cauline leaves. The basal leaves are entire or have 1–5 blunt, short teeth toward the tip. The whole plant is characteristically canescent and densely caespitose. The plant is strikingly different from the other varieties except at the margins of its range.

There is considerable variation in the material included in this taxon. However, this variation is not continuous and may be separated into four types. The original description is based on material that came from the northeast shore of Kotzebue Sound, at Cape Mulgrave. Old atlases have the name Mulgrave Hills on what are called now the De Long Mountains, and Hultén (1945) suggests that Cape Kruzenstern is the same locality as Cape Mulgrave. Material from this area that has been available to us is all entire-leaved. The basal leaves are narrowly oblong, cuneate at the base, and the stem leaves are entire as well. The leaves are densely short-pubescent, but do not have a dusty appearance (like "dusty miller"). This type is most in evidence on the northwest coast of Alaska and on the north slope of the Brooks Range.

A second type is found in the Teller region on Seward Peninsula. This is a conspicuously "dusty-pubescent" population with oblong to broadly oblong or oval leaves that may be rounded at the base. They are healthy, high-grown plants. The basal leaves are entire, but the cauline leaves occasionally have minor lateral lobes near the base of the stem. These two populations are the only ones in the genus found at low altitudes, because in their areas, an alpine flora with high altitude-like environments occurs at sea-level.

A third population is found in the westernmost end of the Brooks Range (the Lake Noluk region and the head of the Coville and Noatak Rivers). It is similar to the material from the volcanic hills on the eastern end of Norton Sound (Qiqertariaq), in which the basal leaves are narrowly oblong, not "dusty", long-leaved and long-petioled, and quite constantly with minor rather acute teeth or minor lobes toward the tips of the leaves. The cauline leaves are long-linear, often with 2 linear, lateral lobes near the base of the blade.

The fourth population is very homogeneous and occupies the central part of the Seward Peninsula: the Kigluaik Mountains, Anvil Hill near Nome, and the hills at Bluff, all about 100 miles apart. The heavy tomentum of this population gives them a "dusty" look; the leaves are oblong or broadly oblong to spatulate, usually 7–11 mm. long and 4–8 mm. wide; many are decidedly rounded at the base and definitely 3–5-blunt-lobed at the

tip. The stem leaves are usually 3-lobed with the lateral lobes nearly the size of the terminal.

It seems entirely reasonable to suggest that the plants from the Lake Noluk and Qiqertariaq regions are intermediate between the Seward Peninsula population of var. *integrifolia*, and var. *Porsildii* from the interior. The evidence for this is their sharing with the interior race the longer-bladed and longer-petioled leaves with more sparse pubescence while retaining the divaricate pedicel branches and broad leaf-blades of the northwestern material. The same type of overlap seems to be repeated in the Anuktuvuk Pass—Oolamnagavik River area.

That the variation involved in these populations is deep seated is supported by examinations of large-flowered plants collected by Coville and Kearney at Port Clarence where two populations meet. In this material the flowers have petals 6 mm. long instead of the usual 4 mm., and the pollen is large and conspicuously irregular ($9.6 \times 10.3\mu$, some pollen grains are 9μ and others 11.2μ in diameter). A more typical average is a diameter of 8.5μ (plants from Colorado and Alaska).

The area that this variety occupies has within it many isolated small or large mountain ranges. The discrete, homogeneous populations within the variety support and emphasize our suggestion that this taxon survived in scattered colonies throughout a general area of persistence. The nature of the adaptation of the species should prepare it for survival under the bleakest conditions of periods of glacial advance and widespread frost activity. However, the species is clearly adapted to dry alpine habitats, not wet tundra. This is pointed up by the appearance of the plant on the well drained gravels of the low altitude Teller Reindeer Station and the gravelly ridges of Anvil Hill while the huge areas of wet tundra habitat in between are empty of the plant. Its populating of slide-rock areas indicates that it is not limited by soil instability.

2e. *Smelowskia calycina*, var. *Porsildii* var. nov.

Stem 1.5–15 cm. long, sparsely puberulent with short branched and long simple or few-branched trichomes; basal leaf-blades shorter than the petioles, linear to narrowly spatulate, 6–(11)–25 mm. long, 1–4 mm. wide, simple or with one or two small teeth at the tip, densely puberulent with whitish, chiefly branched trichomes; petioles 4–(15)–25 mm. long, sparsely

puberulent and hirsute; cauline leaves 2-3, linear, entire or with 2 tooth-like lobes, grading into the basal, 5-10 mm. long, on petioles 1-10 mm. long. Inflorescence in fruit 1.5-(3)-7 cm. long; pedicels in fruit divaricately ascending, their angles of divergence less than 60° ; sepals caducous, oval or oblong, blunt, 2-3 mm. long; petals 3-3.5 mm. long; siliques narrowly oblong, 7-10 mm. long, not flattened; style 0.5 mm. long or less; stigma expanded in fruit; seeds few (1-5). (Illustrated Fig. 3: A 1-4.)

Herba perennis, foliis basalibus linearibus vel anguste spatulatis, 6-(11)-25 mm. longis, 1-4 mm. latis, integris vel 2-dentatis apice; petiolis longioribus quam laminis, 4-(15)-25 mm. longis; foliis caulinis linearibus, integris vel 2-dentatis; sepalis caducis; pedicellis divaricate ascendentibus, angulo minus quam 60° .

The northwestern part of the Central Alaska Uplands and Plains Province (Lobeck 1948) and the south and east slopes of the Brooks Range. The area drains into the Yukon River from the north. **Alaska:** Oolamnagavik R., (west of Killik R. approx. lat. $68^\circ 30'$ N., long. $154^\circ 30'$ W.) June, 1950, *R. Chapman* (no number) (M); Anaktuvuk Pass, dry E.-facing sunny alluvial fan, stony soil with limestone pebbles, common especially near active talus sliding, lat. $68^\circ 17'$ N., long. $151^\circ 25'$ W., elev. 3000 ft., July 11, 1949, *L. A. Spetzman 1894* (M); Brooks Range, dense tufts in phyllite rubble, alt. ca. 3500 ft., Signal Mt. NW of Old John Lake, July 25, 1950, *L. H. Jordal 3710* (Can); Kokrines (approx. lat. 65° N., long. $154^\circ 45'$ W.) 1925, *L. J. Palmer 1566* (US); Kokrines, 1925, *L. J. Palmer 1588* (US); Kokrines Mountains, north side of divide towards Melozitna River, $65^\circ 20'$ N., $154^\circ 30'$ W., elev. 800-4000 ft., dry, gravelly slopes, 2500', June 23-July 5, 1926, *A. E. and R. T. Porsild 741* (Type at Gray Herbarium) (Can, G).

This taxon is characterized by ascending pedicels, caducous calyx, rather fat siliques, and few, entire or 3-lobed stem leaves. The basal leaves are linear with the petioles longer than the blades, entire or with 1-2 sharp teeth at the tip. Plants are densely caespitose with many-branched caudices, each crown with a few leaves, and noticeably green in contrast to the canescent varieties.

The variety has been named for A. Erling Porsild, who has made a number of creditable botanical contributions to our knowledge of the Northwest. His herbarium annotations indicate that he seriously considered describing this variety himself. Porsild (1939) commented on these plants: "Our No. 741 differs from the remainder of the material cited above by having all leaves entire, narrowly ligulate, 20 to 40 mm. long and 3-4 mm. wide, finely clothed with a thin but very dense stellate pubescence."

The population occupies an odd area which seems to be marginal to a region which has produced a very rich endemic flora. Hultén has called it variously, part of Northern Beringia, or an area containing elements of Continental West American Radiants. It is the hilly interior area through which the Yukon and Tanana flow. This "Uplands and Plains Province" was only locally glaciated by mountain glaciers and constituted a large region of persistence. *Smelowskia* seems to have occupied the refugium in the habitats suited to it.

3. *Smelowskia ovalis* M. E. Jones

Smelowskia ovalis M. E. Jones, Proc. Calif. Acad. Sci. V²: 624 (1895).

Loosely caespitose perennial of rocky alpine slopes; caudex rather slender, 1–6 mm. thick, 1–20 cm. long, branched, densely covered with old leaf-bases, each branch terminating in a crown of leaves; stems single to several, slender, simple or usually branched, erect, 5–15 cm. long, sparsely to densely pubescent with short branched and long simple trichomes; basal leaves few to numerous, petiolate, blades oblong to broadly obovate, 3–20 mm. long, 3–15 mm. wide, pinnately divided, the segments obovate and dissected to the midrib, 1–8 mm. long, densely clothed with whitish chiefly branched pubescence; petioles 0.8–(25)–60 mm. long, ca. 1 mm. wide, pubescent with short branched and long simple trichomes; leaf-bases densely pubescent to glabrous in age on the back, not ciliate on the margin; cauline leaves few (1–5), similar but short-petiolate and lobes more slender, tend to be reduced upwards on the stem and may be entire in the base of the inflorescence, densely pubescent. Inflorescence corymbose, elongating but dense in fruit, 1.5–5 cm. long in fruit; pedicels ascending, in fruit 3–8 mm. long, densely pubescent with long simple trichomes; sepals persistent, oblong, 2.5–3.5 mm. long and 1–1.5 mm. wide, pubescent on the back with long simple trichomes, greenish, brown or purple, with a colorless or pink hyaline margin; petals white, cream, or lavender, rounded at the apex, differentiated into claw and blade, 3.5–5 mm. long, ca. 2 mm. broad; stamens nearly equal; filaments terete but often flattened just below the anther making a narrowly club-shaped structure, 2–2.5 mm. long, anthers cordate-ovate, ca. 0.5 mm. long; siliques ovoid to ovate, 3–6 mm. long, 1.5–3 mm. broad, firm, glabrous, slightly expanded at right angles to the replum which is narrowly oblong, obtuse below the style; valves nerved from base to apex by a strong single nerve half way between the valve margins, smooth or with anastomosing raised secondary nerves at the base; style 0.2–0.9 mm. long; stigma expanded in fruit; seeds few (2–6), oblong but pointed on the distal end, marginless; cotyledons incumbent. (Illustrated Plate 1185: B 1–4.)

Typical *S. ovalis* occurs on the high peaks of the Cascade Range in Washington and Oregon. Variety *congesta* has been

found only on Lassen Peak in California. The latter has not been collected since the last eruption of the volcano and the explosive disappearance of the upper portion of the peak. Otherwise there is nothing additional to the information previously noted (Rollins, 1938).

4. *Smelowskia pyriformis* sp. nov.

Perennial plant of slide-rock; caudex single, up to 16 cm. long, clothed with old leaf-bases; root simple and long; stem highly branched, single, up to 14 cm. long, pubescent with short branched and long simple trichomes; basal leaves spread along 3 cm. between caudex and stem, broadly oblong to ovate, 2.5–4 cm. long, deeply pinnately divided, segments as much as 6 mm. long, oblong to elongate oval, densely clothed with whitish chiefly branched trichomes; petioles 1–2.5 cm. long; leaf bases and petioles densely pubescent and hirsute with long, white, simple trichomes; cauline leaves grade into the basal, short petioled, narrowly ovate-spatulate to nearly linear, 1–3 cm. long, the lobes shorter and tending to be reduced upwards on the stem. Inflorescences numerous, 4–9 cm. long, terminating each of many spreading and ascending branches which arise from the axils of leaves along the entire length of the stem; pedicels divaricate to ascending, 3–7 mm. long, pubescent with short branched and long simple trichomes; sepals oval, caducous, 1.5–2 mm. long, 0.8–1.2 mm. wide, sparsely hirsute with long trichomes; petals white or cream-colored, rounded at the apex, differentiated into claw and blade, 2.8–3.2 mm. long, ca. 1 mm. wide; siliques pyriform, rounded above and tapering to the base, 5–8 mm. long, 1.5–2.1 mm. wide, glabrous, often slightly curved in the same plane as the septum when young, not flattened; valves nerved from base to apex by a strong single nerve half way between valve-margins, with a reticulate pattern of barely raised anastomosing secondary nerves, the margins extend beyond the edge of the replum forming a ridge; style 0.5 mm. long or less; stigma inconspicuous in fruit; filament ca. 1.5 mm. long; anthers ca. 0.5 mm. long, cordate-ovate; seeds few (1–5), 2–3 mm. long, wingless; no mature seed examined. (Illustrated Fig. 3: B 1–5.)

Herba perennis lapidis-lapsus, caudice simplice, ad 16 cm. longo, cum basibus foliorum veterum convestita, radice longa, simplice; caule bene ramoso, 14 cm. alto, dense pubescente, pilis ramosis brevibusque et longis simplicibusque; foliis basalibus late oblongis vel ovatis, 2.5–4 cm. longis, 0.75–1.5 cm. latis, alte pinnatifidis, segmentis ad 6 mm. longis, oblongis vel anguste ovalibus, dense incanis, pilis plerumque ramosis; petiolis 1–2.5 cm. longis; basibus foliorum petiolisque dense pubescentibus et capillis longis albis hirsutis; foliis caulinis breve petiolatis, anguste ovato-spatulatis vel paene linearibus, 1–3 cm. longis, ad summam caulis lobis brevioribus reductisque. Inflorescentiis plurimis, 4–9 cm. longis, in apicibus ascendentium-pandentium ramorum, in axillis secundum caulem totum ad summam caulis, pubescentibus, pilis ramosis brevibus paucisque longis simplicibus; pedicellis ascendentibus vel pandentibus, 3–7 mm.

longis, pubescentibus, pilis ramosis brevibus et simplicibus longis; sepalibus ovalibus, sparse longe hirsutis, 1.5–2 mm. longis, 0.8–1.2 mm. latis; petalis albis, apice rotundis, ungue laminaque distinctis, 2.8–3.2 mm. longis, ca. 1 mm. latis; siliculis obovatis vel pyriformibus, apice obtusis, basim attenuatis, 5–8 mm. longis, 1.5–2.1 mm. latis, glabratis, teretibus sed nervatis

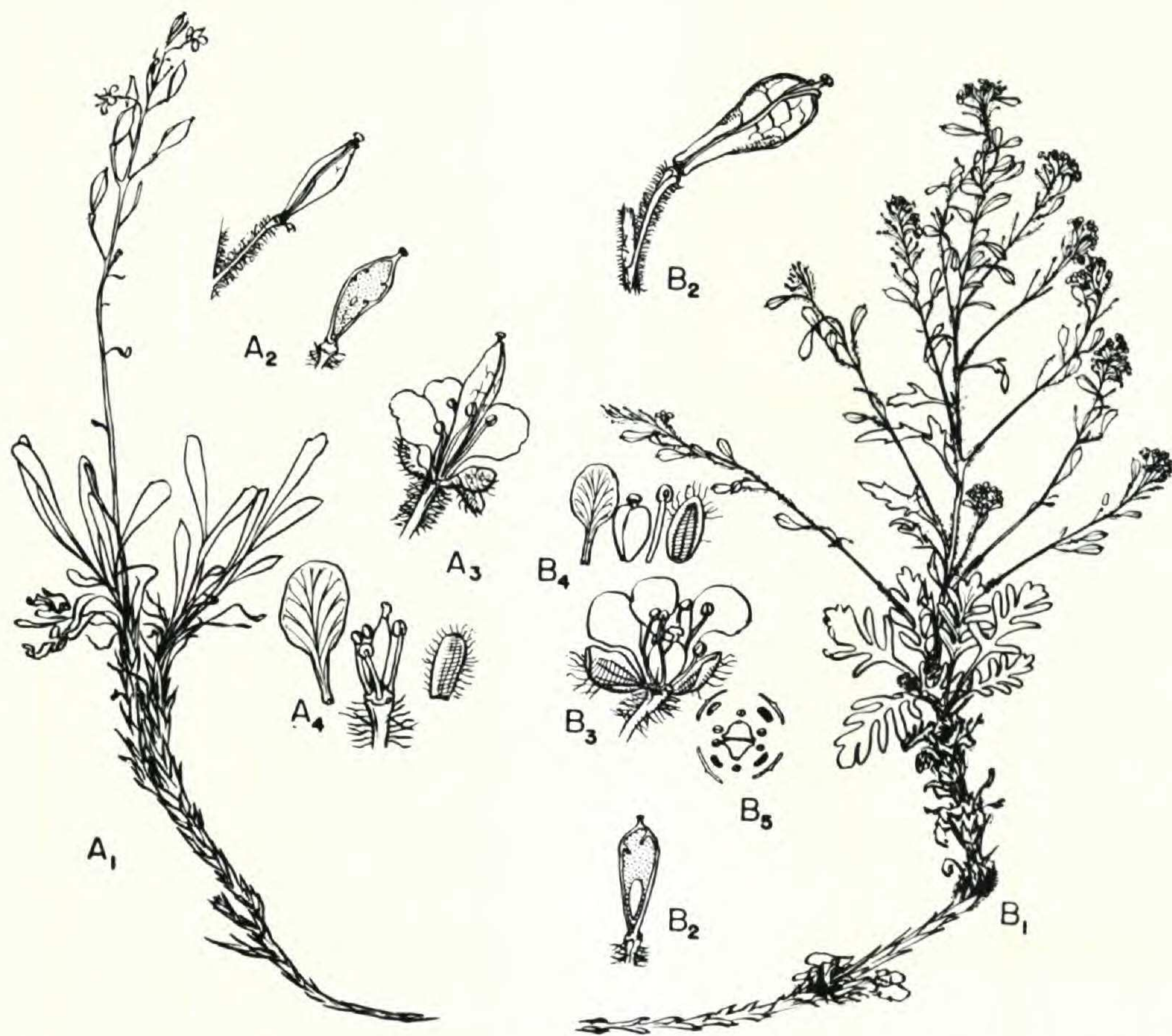


FIG. 3. *SMELOWSKIA CALYCINA*, var. *PORSILDII* AND *SMELOWSKIA PYRIFORMIS*.

A. *Smelowskia calycina*, var. *Porsildii*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 2\frac{1}{2}$); 4) Petal, stamens and young fruit, sepal ($\times 3$). B. *Smelowskia pyriformis*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 2$); 3) Flower detail ($\times 3$); 4) Petal, young fruit, stamen, sepal ($\times 3$); 5) Floral diagram.

inter margines valvarum, valvis reticulatis nervis secundariis anastomosantibus haud elevatis; stylis 0.25–0.5 mm. longis; stigmatibus in fructu haud expansis; filamentis ca. 1.5 mm. longis; antheris ca. 0.5 mm. longis, cordato-ovatis; seminibus paucis (1–5), 2–3 mm. longis, exalatis, seminibus maturis non visis.

Alaska: Kuskokwim River Drainage Basin, Farewell Mountain, growing in active, open, limestone slide-rock; north slope near the top, August 8, 1949, W. H. Drury, Jr., 2783 (Type) (G).

One plant of this clearly marked, new species was collected on the top of a limestone mountain that has been over-ridden by glaciers sometime in the past, as is indicated by the presence of an erratic boulder at the summit. It was very probably not covered during the most recent ice advances.

Smelowskia pyriformis occupies an intermediate position between *Smelowskia* and what has been called variously *Melanidion*, *Ermania*, and *Acroschizocarpus*. That this is the case is amply demonstrated by the following points: (1) The plant grows on active slide-rock, the habitat of the "*Melanidion*" type. *Smelowskia* is usually on gravelly ridges and slopes, but not slide-rock. (2) The flowers are small (petals 3 mm. long) and cream-colored, like *Smelowskia*. Flowers in "*Melanidion*" are purple and larger (3–6 mm. long). Purple flowers do occur in *S. calycina*, var. *americana* and petals 6 mm. long have been found in *S. calycina*, var. *integrifolia*. (3) The stems are branched like "*Melanidion*" or *S. ovalis*. (4) The siliques are marked with raised reticulate veins like "*Melanidion*" (*S. borealis*, var. *borealis*) and *S. ovalis*. (5) The valves extend over the margin of the replum to form a ridge like that in *S. ovalis* and *S. borealis*, var. *Koliana* and less so than in *S. borealis*, var. *borealis* ("*Melanidion*"). (6) The siliques are clearly blunt at the tip and inflated in a plane at right angles to the septum. In this it resembles "*Melanidion*." In *Smelowskia*, the replum is acute at the apex and the siliques barely inflated to slightly so as in *S. ovalis*. The valves are thinner and less firm in all the varieties of *S. borealis* ("*Melanidion*") than in the rest of *Smelowskia* and in this *S. pyriformis* resembles the *S. ovalis-calycina-Holmgrenii* group. (7) The basal leaf-blades are pectinately divided like those of *S. calycina* and *S. ovalis*, not resembling those of "*Melanidion*." (8) The caudex is unbranched, like "*Melanidion*"; those of the rest of *Smelowskia* are branched.

The basal leaves, the flowers, and the pods make it impossible to put this plant into a different genus from *Smelowskia ovalis*. Careful examination, however, showed that the plant actually has more characters of the "*Melanidion*" (*S. borealis*) group to which this species is also inescapably related. On this evidence, there can be no separation of the two genera.

Mature seeds were not found; so that the important character of the position of the cotyledons cannot be established.

5. *Smelowskia borealis* (Greene) comb. nov.

Perennial plant, typically of slide-rock; caudex stout (5 mm. or more in diameter) and simple, or with slender (2 mm. in diameter) stolon-like off-shoots, clothed with old leaf-bases, about 5 cm. long; root stout and long with few branches; stem short, 2–3 cm. long, heavily branched to the base; branches up to 20 cm. long; stem and branches pubescent with short branched, and long simple or few-branched trichomes; basal leaves cover about 1–4 cm. of the caudex and its crown, their blades oblong to ovate to obspatulate, 5–20 mm. long, 5–12 mm. broad, from palmately 3–7-shallow-lobed with the lobes blunt, to sub-pinnately 5-lobed with the lobes slender and acute, pubescent to densely canescent pubescent with short branched trichomes and sparsely to heavily villous with long simple or rarely few-branched trichomes; petioles 5–20(–40) mm. long, pubescent and usually sparsely hirsute with short branched, and long simple or few-branched trichomes; leaf-bases pubescent or glabrous on the back, not conspicuously ciliated in the margin; cauline leaves simple in var. *borealis* to slenderly 5-lobed in var. *Jordalii*, grading into the basal, short petioled, linear to obspatulate, 3–15(–30) mm. long, tending to be entire upwards on the stem. Inflorescences simple, in flower erect, in fruit 8–15 cm. long, often lying along the ground; pedicels becoming recurved after anthesis, secund, 1–2 cm. long, pubescent with short branched, and long simple or few-branched trichomes; sepals oblong, 1.5–3 mm. long, ca. 1 mm. wide, blunt, purple with a purple-hyaline margin or rarely green, hirsute on the back with sparse, simple trichomes; petals differentiated into claw and blade, 3–6 mm. long, 1.5–3 mm. wide (blade oblong to orbicular tapering into the claw), rounded at the tip, lavender to deep purple; filaments 1.5–2(–3.5 in var. *villosa*) mm. long, winged toward the base or tip; anthers ca. 0.3 mm. long, cordate-ovate; siliques obovate to nearly linear, blunt to acute at the tip, 5–19 mm. long, 3–6 mm. wide, wider above than below the middle, glabrous, firm or membranaceous, inflated or uninflated, flattened or expanded in a plane at right angles to the septum; valves nerved from base to apex by a strong single nerve half way between the valve margins, with inconspicuous or conspicuous, anastomosing raised secondary nerves; valve margins extended beyond the replum to form a ridge; style 0.2–1.2 mm. long; stigma expanded or not expanded in fruit; seeds few (5–12), ca. 3 mm. long, wingless; cotyledons incumbent.

KEY TO THE VARIETIES OF *SMELOWSKIA BOREALIS*

Calyx persistent; styles more than 0.5 mm. long; rachis and pedicels either white-villous or with less prominent trichomes.

Pubescence of leaves, stems and pedicels sparse to dense, not predominantly of white-villous trichomes; siliques ovate to obovate, the valves rigid or membranaceous; petals 3–4.5 mm. long.

Siliques rigid, uninflated; replum narrowly obovate;

leaves incanous.....5a. var. *borealis*.

Siliques membranaceous, inflated; replum broadly oblong to lanceolate; leaves densely pubescent, but

scarcely incanous.....5b. var. *Koliana*.

- Pubescence of leaves, stems and pedicels predominantly of white-villous trichomes; siliques oblong, the valves rigid; petals 4–6 mm. long.....5c. var. *villosa*.
 Calyx caducous; styles less than 0.5 mm. long; rachis and pedicels white-villous with an understory of minute branched trichomes.....5d. var. *Jordalii*.

5a. *Smelowskia borealis*, var. *borealis*

Melanidion boreale Greene in Ottawa Nat. **25**: 146 (1912).

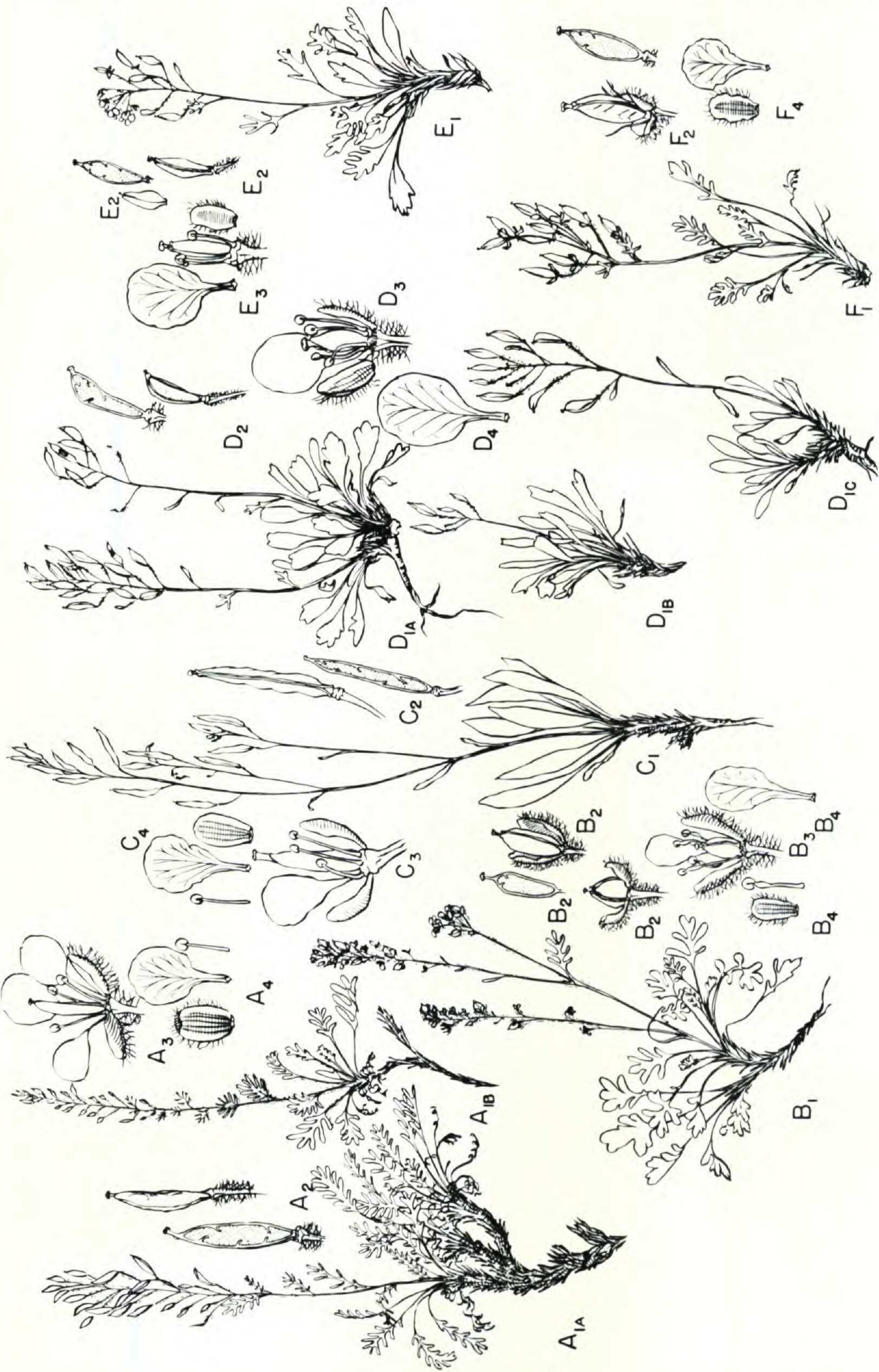
Ermania borealis (Greene) Hultén in Fl. Alaska and Yukon, no. 5, 878 (1945).

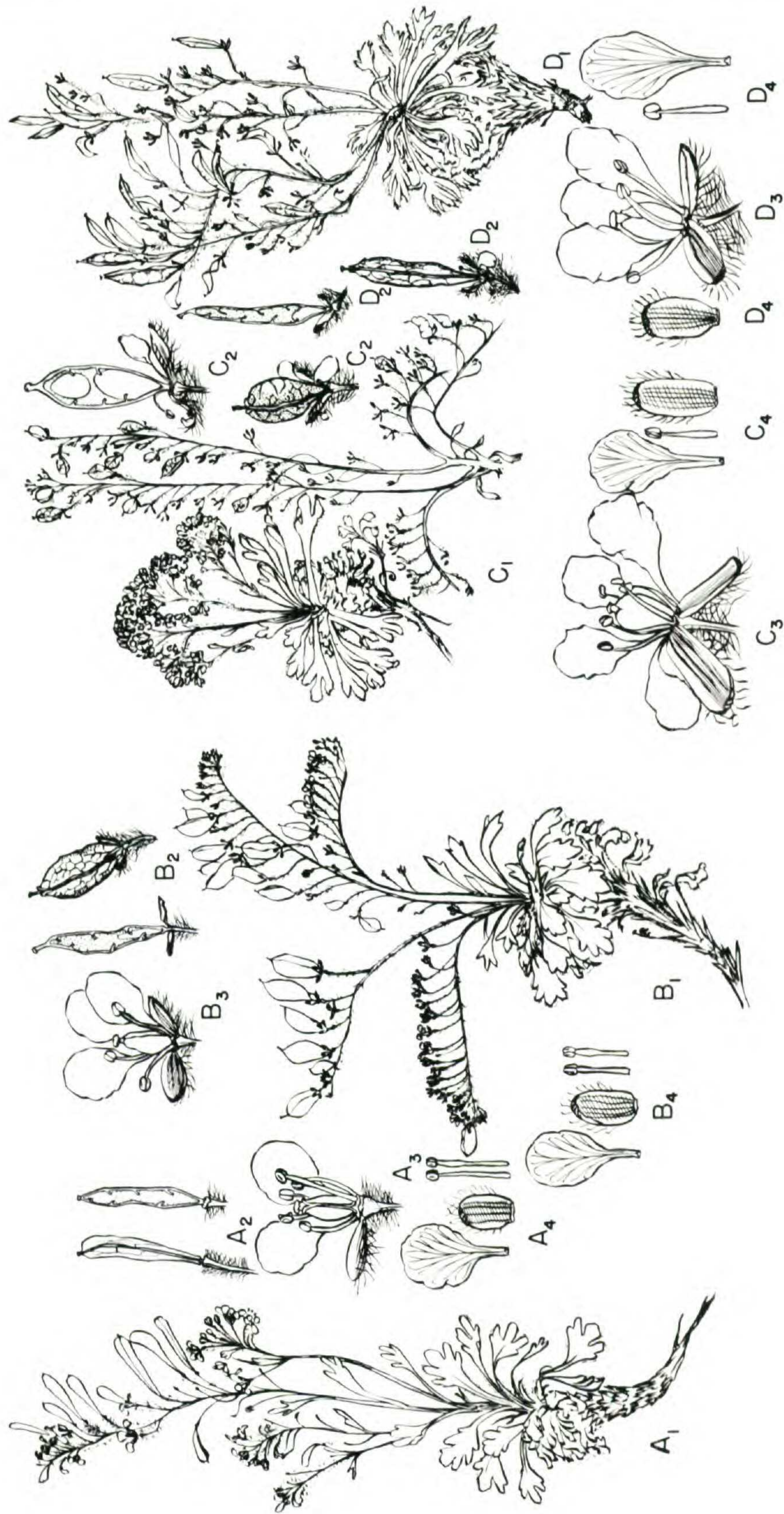
Caudex stout and simple (5 mm. in diameter) or slender (2 mm. in diameter), with few branches and scattered leaf bases where growth has been rapid; stem and branches in fruit rather sparsely pubescent; aestival flowering stems are slender, leafy, and the few flowers are in axils of the entire cauline leaves; basal leaves oblong, ovate, to spatulate, entire or palmately 3-lobed; blades 5–15 mm. long, 2–10 mm. broad, (if tri-lobate the terminal lobe largest), narrowly oblong, blunt, 1–8 mm. long, the base tapering into a broad, 1–2 cm. long, 1–3 mm. wide petiole, densely canescent pubescent with short branched trichomes, and sparsely hirsute with long simple or rarely few-branched trichomes; cauline leaves simple, entire, oblong or linear, sessile or with petioles to 8 mm. long near the base of the stem; pedicels becoming recurved after anthesis, hirsute with long simple or few-branched trichomes; sepals persistent, oblong, 1.5–3 mm. long, with a pale hyaline margin, purple or green; petals 3–4 mm. long; siliques obovate, not inflated, 4–8 mm. long, 2.5–5 mm. wide, valves firm, with conspicuous, anastomosing, raised, secondary nerves; replum obovate to broadly oblong; style 0.7–1.0 mm. long. (Illustrated Plate 1186: C 1–4.)

The Mackenzie Mountains of the Northwest Territories, Yukon Territory, and the Alaska-Yukon boundary.—CANADA: **Yukon Territory**: Runt Creek, 66° 18' N., 141° W., elev. 2300', July 7, 1911, *D. D. Cairnes*

PLATE 1185. *SMELOWSKIA CALYCINA*, *SMELOWSKIA HOLMGRENII* AND *SMELOWSKIA OVALIS*.

A. *Smelowskia calycina*, var. *americana*: 1a) Habit, Rocky Mountain population ($\times \frac{1}{2}$); 1b) Habit, Olympic Mountains population ($\times \frac{1}{3}$); 2) Silique and replum ($\times 1\frac{1}{2}$); 3) Flower detail ($\times 2$); 4) Sepal, petal, stamen ($\times 2$).
 B. *Smelowskia ovalis*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 2\frac{1}{2}$); 4) Sepal, stamen, petal ($\times 2\frac{1}{2}$).
 C. *Smelowskia Holmgrenii*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1\frac{1}{2}$); 3) Flower detail ($\times 3$); 4) Stamen, petal, sepal ($\times 3$).
 D. *Smelowskia calycina*, var. *integrifolia*: 1a) Habit, Nome population ($\times \frac{1}{2}$); 1b) Habit, Norton Sound-Lake Noluk population ($\times \frac{1}{2}$); 1c) Habit, Arctic Coast—North Slope population ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 3$); 4) Petal ($\times 4$).
 E. *Smelowskia calycina*, var. *media*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Petal, stamens, and young fruit, sepal ($\times 2\frac{1}{2}$).
 F. *Smelowskia calycina*, var. *calycina* (? isotype): 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 4) Sepal and petal ($\times 2$).





81.249 (Type?) (Photograph in G ex Can); 67° N., 141° W., June 12, 1912, D. D. Cairnes 83.047 (Photograph in G ex Can). **The Northwest Territories:** Mackenzie Range, Sekwi River, mile 174 E., Pump Station 5, elev. 3625', in a limestone scree, Sept. 6, 1944, A. E. Porsild and A. J. Breitung 11.865 (Can, G); Canol Road, Mountain Range west of head of Bolstead Creek, 6 miles northwest of Pump Station No. 4, mile 111 E., July 25, 1944, V. C. Wynne-Edwards 8318 (Can); Canol Road, Mackenzie Range, Plains of Abraham, mile 82 E., elev. about 6,000', bald, windswept summit of mt., on barren, windswept limestone rubble, September 9, 1944, A. E. Porsild and A. J. Breitung 11809 (Can).

This population is characterized by its short, ovate or obovate siliques with conspicuous, anastomosing secondary veins; persistent calyx; cauline leaves usually simple; basal leaves spatulate, usually equally 3-blunt-lobed, canescent pubescent; stem, branches, and pedicels not conspicuously villous-hairy; style longer than 0.5 mm.; flowers small; sepals 3 mm. long and often with spaces between them.

Porsild (1945) discusses the history of this plant up to the time of publication. His collections considerably extended the range of it and in that report he gives a very complete description of his material. His description includes reference to forking into minor branches at the top of the caudex, and the structure of aestival flowering stems. The herbarium sheets of this material seem to indicate successive periods of burying in the active slide-rock, which would support the explanation that these are adventitious shoots resulting from unusual conditions. He mentions that the flowering stems are stiffly erect and elongate rapidly toward maturity, but does not comment on their fruiting condition in the field. Herbarium sheets indicate the branches become recurved and prostrate in fruit.

PLATE 1186. SMELOWSKIA BOREALIS.

A. *Smelowskia borealis*, var. *Jordalii*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 3$); 4) Petal, sepal, stamens ($\times 3$), note filament is sometimes enlarged toward the tip. B. *Smelowskia borealis*, var. *Koliana*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 2\frac{1}{2}$); 4) Petal, sepal, stamens ($\times 3$), note filament may be enlarged toward tip. C. *Smelowskia borealis*, var. *borealis*: 1) Habit ($\times \frac{1}{2}$); 2) Silique ($\times 1$) and replum ($\times 2$); 3) Flower detail ($\times 3\frac{1}{2}$); 4) Petal, stamen, sepal ($\times 3\frac{1}{2}$), note filament may be enlarged toward the base. D. *Smelowskia borealis*, var. *villosa*: 1) Habit ($\times \frac{1}{2}$); 2) Silique and replum ($\times 1$); 3) Flower detail ($\times 2\frac{1}{2}$); 4) Sepal, stamen, petal ($\times 3$), note filament may be enlarged toward the base.

5b. **Smelowskia borealis**, var. **Koliana** (Gombocz) comb. nov.

Acroschizocarpus Kolianus Gombocz, Bot. Kolzlemenyek **37**: 1 (1940).

Caudex stout, simple, ca. 5 mm. in diameter; stem and branches in fruit sparsely pubescent; basal leaves obovate to broadly spatulate, palmately 3–5-lobed; blades 4–20 mm. long, 3–13 mm. wide; lobes narrowly oblong and acute –7 mm. long, or short and blunt 1–5 mm. long, the terminal one or three longest; leaf-blades tapering rapidly into broad petioles 5–21 mm. long, 1–3 mm. wide; leaves sparsely to densely pubescent with short branched, and long simple or few-branched trichomes; cauline leaves entire upwards, three long-lobed toward the base of the branches, 5–10 mm. long, on petioles 2–15 mm. long; pedicels becoming recurved after anthesis, sparsely hirsute with long simple trichomes; sepals persistent, 2–3 mm. long, dark with narrow scarcely hyaline margin; petals 3.5–4.5 mm. long; siliques oblong, blunt or usually acute, 6–14 mm. long, 4–6 mm. broad, definitely inflated; valves membranaceous, with often conspicuous anastomosing raised secondary nerves; replum narrowly oblong, acute; style 0.8–1.2 mm. (Illustrated Plate 1186: B 1–4.)

Known only from Mount McKinley National Park on the northwest corner of the Alaska Range.—**Alaska**: Alaska Range: Mount McKinley National Park; at the head of the Savage River, July 21, 1936, *Elizabeth Kol 64* [published photograph of type (*Acroschizocarpus Kolianus*)]; near the Muldrow Glacier, on top of McGonnigal Pass (collected by Harold Herning), August 3, 1939, *Aven and Ruth A. Nelson 4315* (W, US); Rocky slope near Camp Eilson, “66,” August 11, 1939, *Aven and Ruth A. Nelson* (no number) (W); Rocky slope near Stony Pass (collected by Fred Warren), July 3, 1939, *Aven and Ruth A. Nelson W-2218* (W, US); Rocky slope near Stony Pass, pods inflated, flowers lavender (collected by Fred Warren), July 3, 1939, *Aven and Ruth A. Nelson 3642* (W, US). Identification doubtful: Alaska: Copper River Region: Ridge between forks of Eagle Creek, alt. 5000 ft., seen only on ridge in rock slides, growing quite flat, 1–2.5 inches in diam., August 22, 1902, *William L. Poto 157* (US).

This population is characterized by its rather long, membranaceous, inflated siliques that are acute at both ends and may have conspicuous secondary veins; persistent calyx, cauline leaves lobed, the lower with long acute lobes; basal leaves palmately 5-lobed with a clearly marked blade, and blunt tooth-like lobes; the stem, branches, and pedicels not conspicuously villous-hairy; style longer than 0.5 mm.; flowers small.

5c. **Smelowskia borealis**, var. **villosa** var. nov.

Caudex very stout, 5–10 mm. in diameter, simple; stem and branches in fruit rather shaggy hirsute; basal leaves oblong or obovate, pinnately or palmately 5(–7)-lobed; blades 8–19 mm. long, 4–12 mm. wide; lobes narrowly oblong, usually acute, 1–10 mm. long, the terminal three often

TABULAR SUMMARY OF THE *pyriformis*—*borealis* GROUP OF *Smelowskia*

Character	<i>S. borealis</i>			
	<i>S. pyriformis</i>	var. <i>borealis</i>	var. <i>Koliana</i>	var. <i>villosa</i> var. <i>Jordalii</i>
Silique length	5.8 mm.	4.5 mm.	6-14 mm.	7-15 mm. 8-19 mm.
Silique proportion length—width	2.5 ×	2 ×	2.5 ×	3 ×
Silique texture	firm not inflated	firm not inflated	membranaceous inflated	firm not inflated membranaceous not inflated
Valves	rounded on back	keeled	keeled	keeled
Secondary nerves	not conspicuous	conspicuous	conspicuous	not conspicuous
Replum	obtuse-obovate	acute or obtuse, obovate or ovate	long, acute	long, acute
Style	less than 0.5 mm.	0.7-1.0 mm.	0.8-1.2 mm.	0.5-1.0 mm. 0.2-0.5 mm.
Calyx	caducous	persistent	persistent	caducous
Petal length	2.8-3.2 mm.	3-4 mm.	3.5-4.5 mm.	4-6 mm. 4-4.5 mm.
Fruiting stem and pedicels	sparsely hirsute	sparsely hirsute	sparsely hirsute	shaggy hirsute
Basal leaves	pinnately 7-9-lobed	palmately 3-lobed at tip	palmately 3-5-shallow-lobed	palmately 3-5-lobed
Basal leaves	densely canescent	densely canescent	thinly pubescent	pubescent densely pubescent
Basal leaves	sparsely hirsute	sparsely hirsute	sparsely hirsute	hirsute sparsely hirsute

equal; leaf-blade tapering into a broad petiole 8–15 mm. long, 1–2 mm. wide; leaves sparsely pubescent with short branched trichomes, and shaggy-villous (sometimes sparsely) with long simple or few-branched trichomes; cauline leaves entire upwards on the stem, 3-lobed near the base of the branches on petioles 4–10 mm. long; pedicels becoming recurved after anthesis, shaggy villous with long simple trichomes; sepals persistent, oblong, 2.5–3.7 mm. long, dark with a narrow scarcely hyaline margin; petals 4–6 mm. long; siliques narrowly oblong acute or blunt at the tip, 7–15 mm. long, 2.5–4 mm. wide; not inflated; valves firm with inconspicuous anastomosing raised secondary nerves; replum narrowly oblong, acute; style 0.5–1.0 mm. long. (Illustrated Plate 1186: D 1–4.)

Herba perennis, foliis basalibus oblongis vel obovatis, pinnate vel palmate 5–7-lobatis; pedicellis in fructu recurvatis, hirsute villosis; sepalis persistentibus; siliquis anguste oblongis, acutis vel obtusis, 7–15 mm. longis, 2.5–4 mm. latis, non-inflatis, firmis; stylo 0.5–1.0 mm. longo.

Known only from Sable Mountain, in Mount McKinley National Park on the northwest corner of the Alaska Range.—**Alaska:** Alaska Range: Mt. McKinley Park, top of Sable Mountain, August 16, 1950, *Olaus Murie* (no number) (Type) (Can); McKinley Park, high up on Sable Mt., June 24, 1941, *Adolph Murie* 179 (W).

This population is characterized by its long, oblong siliques with firm valves and raised anastomosing secondary veins; persistent calyx; cauline leaves lobed; basal leaves rather deeply 5-lobed and villous hairy; stems, branches and pedicels villous hairy; style longer than 0.5 mm.; flowers large (petals about 6 mm. long); sepals contiguous.

The two specimens are one in full flower and one in fruit. Viewed by themselves, they are very distinctive, but on the basis of the intergradation in the other areas of the species we prefer to maintain this as an infra-specific unit. We feel that the four taxa: var. *borealis*, var. *Koliana*, var. *villosa*, and var. *Jordalii* are roughly equivalent. Because there is intergradation between some of them and as yet insufficient evidence that they are distinct species, all should be treated conservatively.

5d. ***Smelowskia borealis***, var. ***Jordalii*** var. nov.

Caudex stout ca. 5 mm. in diameter and simple or 1–3-branched; stem and branches in fruit rather sparsely pubescent; basal leaves generally obovate, unusually spatulate, palmately (3–)5-lobed; blades 3–15(–20) mm. long, 3–10 mm. wide; lobes narrowly oblong, blunt, 1–6 mm. long, the terminal longest; leaf-blade-bases tapering usually rapidly into broad petioles 5–20(–40) mm. long, 2 mm. wide; leaves sparsely to densely pubescent with short branched and few long simple trichomes; cauline leaves 3–5-lobed, petioles 2–22 mm. long; pedicels becoming recurved after

anthesis, hirsute with long simple trichomes; sepals caducous, oblong, 2–2.5 mm. long, dark with a narrow hyaline margin; petals 4–4.5 mm. long; siliques spatulate, blunt, 8–19 mm. long, 2–4 mm. wide, not inflated; valves membranaceous, with inconspicuous anastomosing raised secondary nerves; replum spatulate; style 0.2–0.5 mm. long. (Illustrated Plate 1186: A 1–4.)

Herba perennis, foliis basalibus obovatis, plerumque palmate 3–5-lobatis; pedicellis in fructu recurvatis, hirsutis; sepalis caducis; siliquis spatulatis, 8–19 mm. longis, 2–4 mm. latis, non-inflatis, membranaceis; stylo 0.2–0.5 mm. longo.

The Brooks Range and Romanzof Mountains of north and northeast Alaska.—**Alaska:** Brooks Range: Lake Noluk, shale rubble slope, 5 mi. S. of the lake, lat. 68° 47' N., long. 160° 00' W., elev. 2500 ft., June 7, 1950, *L. A. Spetzman 3511* (M); Pimple Peak, limestone talus, scattered, lat. 68° 40' N., long. 157° 22' W., elev. 2700 ft., August 3, 1950, *Irv. Tailleux 25* (M); Single tufts from long-extended tap roots in rock rubble on bare, steep, high alpine scree-slope, alt. ca. 4000 feet on limestone peaks above Bettles River, 20 miles northeast of Wiseman, July 13, 1949, *Louis H. Jordal 2281* (US, Can); on steep phyllite scree, alt. ca. 3500 feet, Signal Mt., NW of Old John Lake, July 25, 1950, *Louis H. Jordal 3706* (Can). Richardson Mountains: Lake Peters, Romanzof Mountains, sunny mountain shale slope, west-facing, scarce purple-flowered herb, lat. 69° 20' N., long. 145° 00' W., elev. 4500', July 11, 1948, *L. A. Spetzman 597* (Type at Minnesota) (M, S).

This variety is characterized by long membranaceous siliques, blunt at the tip, tapering to the base, with obscure secondary veins; caducous calyx; cauline leaves lobed; basal leaves 5-lobed with rather long and acute lobes; stem and branches, but especially the pedicels, villous hairy; style less than 0.5 mm. long; flowers small; sepals contiguous.

We have named this plant for Dr. Louis H. Jordal who collected during two seasons in the Brooks Range. In the course of those seasons he collected very good material of this plant, including a sheet which seems intermediate between this and var. *borealis*. This sheet is critical in our decision to retain the four entities as varieties of one species. Louis Jordal was killed in an airplane crash in Iran in December, 1951 while acting as Visiting Professor of Botany at the Royal College of Pharmacy and Chemistry at Bagdad.

Vars. *borealis* and *Koliana* are homogeneous and constant populations as is most of the material of var. *Jordalii*. However, in the limited material available in collections at present, we cannot find features of reliable constancy to correlate with the